MOA Number FNA/09-01-01 Effective Date April 16, 2001

MEMORANDUM OF AGREEMENT
between the
FEDERAL AVIATION ADMINISTRATION
AND
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

I. Title: Impact of Aviation Air Emissions on Climate and Global Atmospheric Composition

II. Authority

This Memorandum Of Agreement (MOA) is entered into on behalf of the Federal Aviation Administration (FAA) and the National Aeronautics and Space Administration (NASA) under the authority of the following:

- Agreement between Department of Transportation, Federal Aviation Administration, and National Aeronautics and Space Administration Concerning a Partnership to Achieve Goals in Aviation and Commercial Space Transportation, October, 1998;
- Memorandum of Understanding (MOU) between the Department of Transportation, Federal Aviation Administration and National Aeronautics and Space Administration Concerning Aviation Environmental Compatibility, October, 2000; and
- Section 203(c) of the National Aeronautics and Space Act of 1958, as amended, 42 U.S.C. §2473(c) for NASA and 49 U.S.C. §106 (l)(6) and (m) for the FAA.

III. Purpose

NASA and the FAA are committed to a close partnership in the pursuit of complementary goals in aviation and future space transportation. These goals include aviation safety, airspace system efficiency, environmental compatibility, and others. It has been agreed that in order to facilitate this partnership, the agencies will coordinate their planning efforts, and senior management will monitor the collaborative activities necessary to accomplish these goals.

The purpose of this MOA is to build upon and expand the long-standing relationship between NASA and the FAA with respect to environmental compatibility. Specifically, this agreement aims to form the basis upon which the FAA and NASA may establish programs and plans to determine aviation emissions that have the potential to impact global atmospheric composition, stratospheric ozone and climate.

IV. Background

The FAA is developing a strategy to address aviation's contribution to global climate change, utilizing a modeling capability to assess aviation emissions and emission reductions on a national and/or global scale. The strategy will include an objective to evaluate aircraft emissions and assess potential measures (i.e., best operating practices, new technology, and Communication, Surveillance, Navigation/Air Traffic Management (CNS/ATM) system enhancements) that impact fuel burn, aircraft emission indices, routing, activity level, and fleet mix.

Domestic concern about environmental impact of emissions may cause a major impediment to aviation's future growth and development. Increasingly stringent ozone and particulate matter standards under the Clean Air Act have resulted in local authorities and environmental groups demanding action from Federal agencies and air carriers to mitigate NO_x emissions (that contribute to tropospheric ozone production) and other pollutants. Many urban areas in the US are not in attainment with the health-based National Ambient Air Quality Standards. State and local governments are developing programs to reduce emissions of harmful pollutants, but often find it difficult to achieve their goal without reductions in emissions from so-called national sources, such as motor vehicles, locomotives and aircraft. Thus FAA is developing a strategy to address aviation's contribution to local air quality, utilizing an updated, expanded, and validated emissions and dispersion modeling capability.

The FAA and Environmental Protection Agency (EPA) have agreed to work cooperatively with all parties to explore development of a program to obtain ground-level emissions reductions from the aviation sector in the near and long term. The aviation industry, state air quality officials, and environmental organizations are identifying and assessing the potential benefits and feasibility of incorporating various aviation emissions reduction measures under a voluntary program. Similarly, the EPA and NASA are working with the aviation industry to identify voluntary measures for the reduction of greenhouse gas emissions.

FAA has completed a preliminary assessment of the Emissions and Dispersion Modeling System (EDMS) in order to identify areas for improvement. EDMS is designed to assess the air quality impacts of airport emission sources, particularly aviation sources, which consist of aircraft, auxiliary power units, and ground support equipment. Current FAA policy identifies EDMS as the required model to perform air quality analyses for aviation sources. The FAA will use this assessment, along with guidance from its government/industry advisory board, to enhance the model to better evaluate emission levels and concentrations generated by typical airport/air base emission sources.

Results of NASA research activities under the Atmospheric Effects of Aviation Project (AEAP) indicate that aviation's present influence on climate and the ozone layer is small compared to that of all human activities, although its role may increase in the future due to traffic growth. The scientific findings from the AEAP served as a significant input to the Special Report on Aviation and the Global Atmosphere that was prepared and published by the Intergovernmental Panel on Climate Change (IPCC) in April 1999. The IPCC report indicates that, along with the expected production of the greenhouse gas carbon dioxide (CO_2), aviation's impacts on climate also include significant production of the tropospheric ozone, which acts as a greenhouse gas, and the nucleation effect of contrails and cirrus clouds. However, the scientific understanding of contrails and cirrus clouds lacks certainty at present. The IPCC report also includes potential impacts of future supersonic aircraft on stratospheric ozone. The FAA will continue to use this information along with the up-to-date scientific assessments by the NASA Atmospheric Effects of Aviation Focus Area to assist in developing future policies and programs to reduce aviation's impact on the environment.

NASA has completed research activities under the Advanced Subsonic Technology (AST) program to develop combustor technology to reduce aircraft engine exhaust emissions. Through a series of laboratory tests and demonstrations with aircraft engines, the new combustion technologies have been shown to be able to achieve the AST nitrogen oxide (NOx) emission goals. The tests indicate that the 50% NOx reduction goal for the landing-takeoff (LTO) cycle may be achieved. Progress made under the AST program is being taken into account, by the FAA, during the development of long term technological goals, as part of the work program of the Committee on Aviation Environmental Protection (CAEP), under the International Civil Aviation Organization (ICAO).

Aviation is a global industry for which uniform standards and global solutions are necessary. In this regard the ICAO maintains an active environmental program under its CAEP. CAEP is charged with the development of international standards and recommended practices for measuring and controlling gaseous engine emissions. At the second meeting of CAEP, held in December 1991, it was agreed that the LTO emissions standard for oxides of nitrogen (NO_x) would be reduced by 20% from the original 1981 level. The newer standard applies to individual engines manufactured after December 31, 1999. At the fourth meeting of CAEP, held in April 1998, it was agreed that NO_x emissions would be reduced an additional 16% from previous levels. This most recent ICAO standard will apply to engine types or models that receive certification after December 31, 2003.

Working Group 3 of the CAEP is tasked with assessing technologies and studying the potential for new aircraft emissions certification schemes. Historically, CAEP activities concerning emissions have been directed towards improving methods for measuring gaseous engine emissions, and considering increases in stringency of the standard for NO_x.

Over the next few years CAEP expects to further develop the aircraft engine exhaust emissions standards. This activity will include the further development of the scientific basis for assessment of the atmospheric effects (ground level and upper atmosphere) caused by engine exhaust emissions, an assessment of new certification regimes that take into account the performance of the whole aircraft during all appropriate phases of flight (e.g. climb and cruise), and limits on emissions that are progressively more stringent in future years. The degree to which these limits are made more stringent will depend upon results of assessments that will be conducted to ascertain the state of the scientific understanding of emission effects, and the state of technology and operational readiness to achieve reductions in emissions.

V. Scope

Together NASA and the FAA will develop a broad based plan to assess aviation's contribution to global change, including application of global atmospheric models, developed through the NASA Earth Science Enterprise's (ESE) research and analysis program, to assess impacts of aviation on global atmospheric composition and climate.

NASA and the FAA will focus their efforts on defining tasks to meet the overall goals/objectives of this MOA, and on ensuring a coordinated series of activities to lead to improved technology related to minimizing the impact of aviation-related gaseous and particulate emissions on global atmospheric composition and global change (ozone depletion and climate change).

Specifically, NASA and the FAA will conduct the following analyses and studies of aircraft and airport operations and development programs, and mitigation measures that strategize solutions for aviation, which could lead to the reduction of any adverse impact on the environment while maintaining the safety, efficiency, and capacity of the National Airspace System.

A. Technology Assessment

NASA and the FAA will collaborate to assess NASA-developed technologies, current and future, for reducing emissions that may impact local air quality and the global climate change. This effort will involve the assessment of NASA technologies using FAA emissions modeling tools and/or other applicable modeling tools. Applicable technologies, along with theoretically estimated time frames for their introduction into representative national and global fleets, may include the products of NASA's AST, Ultra-Efficient Engine Technology (UEET) and Power and Propulsion Systems Base programs.

B. Global Emissions Inventory Modeling

NASA and the FAA will collaborate to support the FAA's strategy to address aviation's potential contribution to global climate change and ozone depletion, specifically the use of an FAA modeling capability to assess aviation emissions and emission reductions on a national and/or global scale. NASA will support this strategy by providing technical input and guidance related to methodologies for estimating aviation emissions. Proprietary data such as aircraft performance data and calculations, fuel burn and emissions characteristics (i.e., emissions indices), may be of value for estimating fleet-wide emissions. NASA has historically worked with private industry to access such data, which has been provided in a form that does not jeopardize engine manufacturer interests. Other technical input may include systems analysis of representative aircraft fleet "classes" for estimating total mission fuel burn (and therefore total CO_2) and NO_x emissions. Guidance may include technical review of, and input to proposed methodologies (or elements of methodologies).

C. Emissions Characterization

NASA and the FAA will collaborate to support FAA's strategy to establish a complete aircraft gaseous and particulate emissions database. NASA will support this strategy by providing technical input and guidance related to characterization of gaseous and particulate emissions from current and future combustors and engines. Technical input may include gaseous and particulate data acquired and processed to become "generic" by NASA. Guidance may include study results on particulate and aerosol precursors sampling issues.

VI. Technical Representatives

The following individuals are responsible for oversight of this MOA in their respective agencies; however, they do not have authority to unilaterally alter any of its terms.

NASA: Mr. Neal Nijhawan, Environment Goal Manager, Subsonic Transportation Division, Office of Aerospace Technology (Code RG)

Dr. Chowen Chou Wey, Environmental Impact Manager, High Speed Systems Office, Glenn Research Center at Lewis Field

FAA: Mr. Curtis A. Holsclaw, Manager, Emissions Division, Office of Environment and Energy (AEE-300)

VII. Dissemination of Information

To the extent permitted by applicable law, the initial release of any information for public consumption, oral or written, concerning results or conclusions made pursuant to performance of this MOA shall require prior written approval of the Technical Representatives, FAA and NASA.

VIII. Proprietary Information

Both parties recognize the importance of protecting proprietary information from unauthorized disclosures. Protection of proprietary data is considered vital to the success of viable technologies, and both parties will take appropriate measures to assure such protection.

IX. Period of Performance

The period of performance for this MOA shall commence upon the effective date of the MOA and shall remain in effect for eight (8) years.

X. Modification and Termination

Any modification of this MOA must be in writing and executed by NASA and FAA signatories or their designated representatives, acting within the scope of their authority.

Either agency may terminate this MOA 180 days after giving notification to the other party of intent to terminate. Upon termination, each agency will refund any portion of those funds that have been advanced, but not expended, in connection with the work specified in the MOA.

XI. Funding

All activities under or pursuant to this MOA are subject to the availability of appropriated funds, and no provision herein shall be interpreted to require obligation or payment of funds in violation of the Anti-Deficiency Act, 31 U.S.C. §1341. This MOA is not a funding document, and does not represent the obligation or transfer of funds.

XII. Effective Date

The effective date of this MOA shall be the date of the last signature below.

National Aeronautics and Space Administration

Samuel L. Venneri
Associate Administrator for Aerospace Technology

APR 0 9 2001

Date

Department of Transportation
Federal Aviation Administration

Louise E. Maillett
Assistant Administrator for Policy, Planning,
and International Aviation (Acting)

April 16, 2001

Date